250

General Science, Space, and Technology

Function 250 includes federal funding for broadly based scientific research and development. It includes research funding for three agencies: the National Aeronautics and Space Administration (NASA), the National Science Foundation, and the Department of Energy's (DOE's) general science programs. (Federal funding for research and development related to agency missions or particular industries, such as defense, health, or agriculture, is included in those respective budget functions.)

Over half of the funding in function 250 is devoted to NASA's space and science programs, including the International Space Station, space shuttle, space-based observatories, and various robotic missions. The National Science Foundation, which accounts for about 22 percent of the 2005 funding in this function, is the government's principal sponsor of basic research at colleges and universities; most of its money is distributed as grants to individual researchers. DOE's general science programs (which received appropriations of about $3.6 billion for 2005) support specialized facilities and basic research in such areas as high-energy and nuclear physics, advanced computing, and biological and environmental sciences.

Almost all of the funding in function 250 is discretionary. Spending for this function has increased consistently for several years, growing at an average annual rate of 5.5 percent from 2000 through 2004. In 2005, spending is projected to reach $23.4 billion, an increase of 1.6 percent from the previous year.

Federal Spending, Fiscal Years 2000 to 2005 (Billions of dollars)

						Estimate	Average Annual Rate of Growth (Percent)	
	2000	2001	2002	2003	2004	2005	2000-2004	2004-2005
Budget Authority (Discretionary)	19.2	20.9	21.9	22.9	23.4	24.3	5.0	4.0
Outlays								
Discretionary	18.6	19.7	20.7	20.8	23.0	23.4	5.4	1.7
Mandatory	*	*	0.1	0.1	0.1	0.1	25.7	-13.3
Total	18.6	19.8	20.8	20.9	23.1	23.4	5.5	1.6

Note: * = between zero and $50 million.

250-01—Discretionary

Cut the National Science Foundation's Spending on Elementary and Secondary Education

(Millions of dollars)	2006	2007	2008	2009	2010	Total 2006-2010	Total 2006-2015
Change in Spending							
Budget authority	-188	-191	-194	-198	-202	-973	-2,036
Outlays	-23	-98	-152	-176	-184	-633	-1,617

In 2005, the National Science Foundation (NSF) received $182 million to promote better science and math education in elementary and secondary schools. Those programs primarily work to improve teacher training and continuing education, but also to develop instructional and assessment materials. This option would eliminate funding for those efforts. Implementing this option would save $23 million in outlays in 2006 and $633 million over five years. (This option would not affect the Math and Science Partnership, which is included in the No Child Left Behind programs.)

Proponents of this option argue that the NSF's efforts duplicate the efforts of much larger programs in the Department of Education and of state and local governments. Such programs include those under the No Child Left Behind Act, which mandates more qualified teachers (in all fields, not just science and mathematics) and provides some resources to develop teachers' skills. The act also mandates more systematic assessments of students' progress in science, reading, and math over different grades. Currently, the Department of Education is spending $24 billion helping elementary and secondary schools with the No Child Left Behind efforts, including in the areas of science and mathematics. As noted above, the NSF currently operates a program to aid the No Child Left Behind Act in meeting its math and science goals.

In the 2000-2001 school year, state and local governments spent $370 billion on public elementary and secondary education. Many state and local governments continue to devote resources to the quality of education that all their teachers receive, including their math and science teachers. Given the high levels of funding that are being spent in agencies with the primary responsibility for education, the NSF's efforts may be inconsequential.

Opponents of this option argue that the NSF leverages its small contribution by focusing on the basic aspects of educational research while allowing other agencies to implement and develop programs that apply such research. Thus, for example, NSF programs focus on providing professional resources for instructors of science teachers, while the No Child Left Behind and Math and Science Partnership programs implement quality improvement measures for the science teachers themselves. Furthermore, some note that the current federal funds for teacher quality grants under the No Child Left Behind Act are inadequate.

250-02—Discretionary

Cancel the Crew Exploration Vehicle and Lunar and Mars Exploration Programs in 2006 and Retire the Shuttle After Completion of the International Space Station in 2010

						Total	
(Millions of dollars)	2006	2007	2008	2009	2010	2006-2010	2006-2015
Change in Spending							
Budget authority	-1,493	-2,023	-2,097	-2,720	-3,178	-11,511	-44,042
Outlays	-1,015	-1,749	-2,006	-2,497	-2,976	-10,243	-40,801

Note: Estimates are based on the National Aeronautics and Space Administration's fiscal year 2005 program and longer-term plans for implementing the Administration's new vision for space exploration.

On January 14, 2004, President Bush proposed a new vision for space exploration that includes human and robotic exploration of the Moon and Mars. The National Aeronautics and Space Administration's (NASA's) 2005 budget allocates the majority of funding for the Moon/Mars initiative to two programs: the Crew Exploration Vehicle (CEV), to be used to transport humans to both the International Space Station and to lunar orbit; and Lunar Exploration, robotic exploration of the moon that includes the development and launch of lunar orbital satellites and landing rovers. In later years, the initiative would also include costs for projects not reflected in the current budget, including development of a heavy launch vehicle and a lunar exploration module. Current NASA projections indicate that much of the funding for the initiative will come from phasing out the space shuttle by 2012. NASA envisions returning humans to the Moon no later than 2020.

This option considers the savings from avoiding all planned and expected activities associated with the initiative. It would cancel Moon/Mars Exploration Initiative activities while continuing to phase out the space shuttle as currently planned. Thus, the option would postpone America's robotic exploration of the Moon and human exploration of space beyond the confines of low-Earth orbit (LEO). This option would reduce planned NASA spending by $1 billion in 2006 and $10 billion over five years.

Proponents of this option contend that the new vision for space exploration supersedes the obligations the United States has made to its international partners on the International Space Station and causes unnecessary turmoil to the robotic and scientific missions NASA had previously planned to perform. They also note that pursuing the initiative requires abandoning NASA's previous plans for a space-launch initiative to develop more affordable and reliable means of transporting both humans and cargo to space. Supporters further argue that without real growth in NASA's budget, pursuing the initiative requires that the space shuttle be retired from service in 2010, leaving the United States dependent on the Russian Soyuz capsule for transportation to space for at least four years while the CEV is in development. Although this option phases out the shuttle by 2012, canceling the Moon/Mars initiative could free up funding to be used to recertify the space shuttle for continued flight or to pursue an affordable and reliable replacement for it. Such an approach would be necessary if the United States wanted to sustain a capability to conduct human spaceflight.

Opponents of this option argue that the Moon/Mars Exploration Initiative is the next logical, long-postponed step in human space travel. Without the challenges of exploring beyond LEO—in particular, returning to the Moon and traveling to Mars—NASA will lack the focus that was essential to the success of the original Apollo moon-landing program. Further, they argue that without those challenges, NASA and the American aerospace industry will be unable to attract and retain the scientific talent they need to remain vital.

RELATED CBO PUBLICATION: *A Budgetary Analysis of NASA's New Vision for Space Exploration,* September 2004

250-03—Discretionary

Cancel Research on the Next Generation of Nuclear Reactors for Powering and Propelling Spacecraft

						Total	
(Millions of dollars)	2006	2007	2008	2009	2010	2006-2010	2006-2015
Change in Spending							
Budget authority	-441	-449	-459	-468	-478	-2,295	-4,842
Outlays	-300	-416	-446	-462	-472	-2,096	-4,609

Project Prometheus is slated to develop the technology needed for a high-power, space-qualified nuclear reactor. The nuclear systems developed under Project Prometheus would provide at least 100 times more power than current solar or nuclear power systems provide for spacecraft. Such high-power nuclear systems could be used to support long-duration human stays on the Moon, human flights to Mars, and long-duration robotic exploration of the solar system. For example, the National Aeronautics and Space Administration (NASA) had planned the Jupiter Icy Moon Orbiter (JIMO) program to be a mission to use the technology developed under Project Prometheus. The JIMO mission proposes to orbit the three planet-sized moons of Jupiter—Callisto, Ganymede, and Europa—and investigate the origin and evolution of those moons, examine each moon's potential to sustain life, and survey locations for landing craft. (The President's 2006 budget plan postpones the JIMO mission, pursuing first a demonstration of the use of nuclear power in space.)

By canceling Project Prometheus, this option would save NASA $300 million in outlays in 2006 and $2.1 billion over five years, according to figures in NASA's 2006 budget request and associated longer-term plan.

Proponents of this option argue that the risks associated with launching the amount of nuclear material needed for high-power space reactors outweigh the benefits associated with the improved ability to explore the solar system. In addition, some supporters of this option question whether the long-duration human missions beyond low-Earth orbit that Project Prometheus would enable should be a priority in a time of constrained budgets.

Opponents argue, however, that canceling Project Prometheus would severely constrain future options for both human exploration beyond low-Earth orbit and robotic exploration of the solar system. In particular, canceling the project would make it unlikely that NASA's current plan for JIMO could be achieved and also could preclude future human exploration of Mars and long-duration human presence on the Moon.

RELATED CBO PUBLICATION: *A Budgetary Analysis of NASA's New Vision for Space Exploration,* September 2004

250-04—Discretionary

Cancel the Shuttle Program and Additional Assembly of the International Space Station

(Millions of dollars)	2006	2007	2008	2009	2010	Total 2006-2010	Total 2006-2015
Change in Spending							
Budget authority	-4,981	-5,075	-5,182	-5,290	-5,400	-25,928	-54,688
Outlays	-3,387	-4,696	-5,042	-5,221	-5,330	-23,676	-52,058

On February 1, 2003, the Shuttle Columbia was lost during re-entry. On January 14, 2004, the National Aeronautics and Space Administration (NASA) unveiled the President's long-term vision for space exploration, which stated that the remaining fleet of space shuttles would return to flight to complete construction of the International Space Station (ISS) by about 2010. The ISS would operate through 2017, with its research agenda refocused to explore issues associated with long-duration human spaceflight. According to NASA, about 25 to 30 space shuttle flights will be needed to complete construction of the ISS.

Under this option, the shuttle program would be terminated immediately and the ISS would remain in its current configuration, saving NASA $3.4 billion in outlays in 2006 and $23.7 billion through 2010, according to the agency's latest five-year program plan. Access to the ISS would continue to be provided by Russian Soyuz launches.

Supporters of this option argue that the goal of completing construction of the ISS by 2010 using the space shuttle is optimistic. That schedule dictates that the space shuttle make an average of six flights per year over the next five years. Taking into account NASA's implementation of the findings of the Columbia Accident Investigation Board (CAIB), especially the constraints of executing only daytime launches and the need to have a backup orbiter prepared to conduct a potential rescue, it may be a challenge for NASA to achieve that launch schedule.

Justification for this option stems from the observation that even if the space shuttle is used to complete construction of the ISS, retiring the shuttle as planned in 2010 could jeopardize the capability to conduct the scientific experiments planned by the station's international partners. This is the case because only the shuttle has the capability to transport the materials to and from the station for those experiments. In addition, retiring the shuttle will constrain, if not eliminate, the capability to conduct maintenance and repair of the station needed to keep it viable through 2017.

Opponents of this option argue that the United States has an obligation to its international partners to complete ISS construction and that the shuttle is essential to that task. Moreover, they add that the ISS is a critical component to executing the President's vision for space exploration by providing a platform for carrying out tests and observations into the biological effects of long-duration human exposure to zero gravity. In addition, NASA is currently working on plans that might make it possible to support the international experimentation program originally planned to provide transportation capability in the absence of the shuttle.

Furthermore, opponents argue that by retiring the shuttle in 2005, production lines for support components like the external tank, solid rocket boosters, and the shuttle's main engines would be lost. Closing those production lines in 2005 could make it more difficult to use those systems or derivatives of them in future launch vehicles. For example, developing a cargo version of the shuttle launch system—the so-called Shuttle-C—has been proposed as a low-cost path to a new heavy launcher, a capability that may be required for lunar exploration missions and that will almost certainly be required for human exploration of Mars.

RELATED CBO PUBLICATION: *A Budgetary Analysis of NASA's New Vision for Space Exploration,* September 2004